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Mounding benefits replanting avocado root rot orchards

GE GOODALL, HD OHR and GA ZENTMYER
University of California Cooperative Extension, 377 Storke Rd, Goleta, CA 93117, USA

SYNOPSIS
The most beneficial treatment when replanting root rot-diseased orchard sites with partially resistant rootstocks, is to plant the trees on mounds. Pre-plant soil fumigation with methyl bromide is *also beneficial These findings support the combination treatments in replanting diseased* Phytophthora cinnamomi *soils, which include resistant rootstocks, mounds, fungicides and careful irrigation management.*

INTRODUCTION

Replanting avocado orchard sites infected with *Phytophthora cinnamomi,* has generally failed in the past in southern California. Recent trials have tried to combine all the known factors that aided in young tree growth: resistant rootstocks, planting on mounds, pre-plant soil fumigation, post-plant fungicide applications and precise management, especially careful drip irrigation.

This paper reports on the results of using mounds, as well as pre-plant soil fumigation. Coftey (1) and Kotze & Darvas (3) have fully described what they term 'Integrated Control'.

The replanting of trees on shallow or very dense soils in the Santa Barbara area, has occurred since the 1940s, mainly to avoid drowning out during heavy rainfall periods.

With the availability of the clonally propagated Duke #7 rootstock and drip irrigation, the use of mounds in replanting root rot-infected sites started in the 1970s, with promising results.

RANCHO COLINAS TRIALS

A preliminary trial started in 1978 with encouraging results, but was abandoned because of poor design and erratic results. Another trial was designed and initiated in 1981, at the same site on Rancho Colinas, owned by the Don Petty family in the foothills near Carpinteria. The soil is mapped Milpitas-Positas fine sandy loam (4): it is an old terrace soil, two to three feet deep, with a nearly impervious clay pan and a slope of 2 to 5 per cent.

A factorial experiment was designed, using a random block design with nine trees in each treatment. All 144 trees were commercial nursery trees of Hass variety on clonal Duke #7 rootstocks. The trees were planted in July 1981. The treatments were:

1. **Mounds -** built by scraping soil from topsoil nearby, so that the mound was at least 0,5 m high, 0,2 m across the top, with the soil resting at its natural angle of repose; this made the base at least 1,0 m in diameter at the original soil level.

2. **Pre-plant** soil fumigation - using methyl bromide gas, each tree site was treated with 1,4 kg per 5,8 m^2, with half of the MB placed at 1 m and half at 1/2 m depths below the soil surface at the planting site; the soil surface was covered by a 4 mm polyethylene tarp for 48 hours.

3. **Post-plant chemical injection with the irrigation water -** using an initial dosage as listed at each irrigation of 16 litres per tree in about weekly intervals:

a Metalaxyl (Ridomil) - 10 ppm
b Phosetyl-Al (Alietteo) - 10 ppm
c Terrazole® - 25 ppm

One emitter was placed at or near the trunk of each tree. In the third year, two additional emitters were added.

RESULTS FAVOUR MOUNDS

After three years of treatments and growth, the authors realised that the plastic hose distribution system, which provided water and injected chemicals to the trees, was not according to the randomisation plan. Tracing out the lines and treatments for evaluation, they were able to associate some trees with the proper treatments, but not enough for an adequate statistical analysis. Limited observation suggested that the treated trees had not benefited from any of the applied chemicals. The chemicals had been distributed equally to the factorialised other two treatments - mounds and pre-plant fumigation - so these two could provide significant data.

Trees were periodically rated for disease symptoms using the 0 to 5 visual scale established by Zentmyer (5). These observations are presented in Table 1 for the first three years of growth. The ratings for the fourth and fifth years are not presented, since the treatments showed no significant visual benefits. Benefits at the end of the first year, were highly significant for trees planted on mounds - only slightly less than normal (0,2 on the 0 to 5 scale), compared to trees planted on the flat that were well into disease symptoms (1,7 on the 0 to 5 scale).

By the end of two years in the field, the trees on mounds were rated visually at 0,7 - a slight yellowing - compared to check trees at 1,4. By the third year, no significant differences occurred - all trees showed equal disease symptoms, but those on mounds were significantly larger as shown in Table 2.

Trees that received pre-plant soil fumigation with methyl bromide benefited significantly - 0,5 - compared to non-fumigated of 1,7 the first year. The benefits waned in the second year and were no longer visually present by the third year.

The combination of both mounds and pre-plant fumigation did not benefit the trees more than the mound treatments alone. However, both treatments resulted in larger trees in the five-year evaluation.

DISCUSSION OF USEFULNESS

There is little doubt that, when replanting with partially-resistant rootstocks, mounds benefit the trees the first few years. This gives these trees better size and growth potential for the years to come. In the long run, the replanted tree will survive or fail depending on the virulence of the disease at that site and other management and environmental conditions.

Other experiments by Coffey (1) have demonstrated that treatment with metalaxyl will protect the replants and allow them to grow as well as when preplant soil fumigation is practised. Metalaxyl has generally become commercially used in southern California when replanting.

Observations by the senior author in many orchards, where drowning was a problem, have shown that mounds are preferable to contoured terraces or ridges for this benefit, which is mainly attributed to better aeration and drainage. Where mounds are built, there is no collection of heavy rains or run-off near the trees. This nearly always occurs on contoured terraces when the cross slope is less than 1 per cent. Greater terrace slopes lead to more severe erosion.

When orchards are planted on slopes exceeding about 30 per cent (15 degrees), there is no need to build mounds. In addition, they do not seem necessary in very porous, sandy, or rocky sites.

CAREFUL DRIP IRRIGATION REQUIRED

The efficacy of mounds in replanting root rot orchards is completely dependent on using drip irrigation. Placing an emitter at the trunk of the tree for the first two years, is both effective and essential.

Usually by the second season, or in the third year for sure, one or two more emitters are placed on the tubing about 1/2 m from the first. By the fourth season a mini-sprinkler may be placed on the tubing between the trees, but one or two emitters should remain on the mound for a further period of two or three years. When the tree is fully established as a mature tree, the emitters may be removed from the mound.

Irrigation management is best accomplished by tensiometers, with a 0,3m instrument placed in the lower portion of the nursery tree ball and a 0,6 m unit placed directly below. Irrigation scheduling starts when the 0,3 m tensiometer reads at least 20 centibars, but not more than 30 centibars. The length of run is judged by the readings on the 0,6 m unit, within this same range (see article by Goodall (2) for more details).

TABLE 1 Avocado root rot replant treatments: disease visual ratings for three years (Rancho Colinas, Carpinteria).

Treatments	No of Trees	Root rot visual ratings*		
		1 yr old	2 yrs old	3 yrs old
On mounds	72	0,21 a**	0,72 a	1,40 a
Pre-plant fumigation	72	0,47 a	0,61 a	1,56 a
Mound & fumigation	36	0,21 a	0,57 a	1,35 a
Check	36	1,65 b	1,42 b	1,58 a

*Visual scale: 0 - healthy; 1 - slight yellowing; 2 - pale foliage and lacks new growth; 3 - small, pale leaves and defoliation beginning in top of tree; 4 - moderately defoliated and beginning die-back; 5 - severe defoliation and die-back, nearly dead. As per GA Zentmyer (5).
**Duncan Multiple Range Test at five per cent significance.

TABLE 2 Avocado root rot replant treatments: tree size results (Rancho Colinas, Carpinteria),

Treatments	No of trees	Size rating* at 5-year-old
On Mounds	72	2,4 a**
Pre-plant fumigation	72	2,3 a
Mound & fumigation	36	2,6,a
Check	36	1,5 b

*Visual scale: 3 - large; 2 - medium; 1 - small; 0 - dead.
**Duncan Multiple Range Test at five per cent significance.

OBSERVATIONS IN OTHER REPLANT ORCHARDS

Some growers have tried building larger mounds, with good results. Others still, have mixed in manures, composts, or other organic matter when building the mounds. All mounds need to be well-settled before planting. These seem beneficial and more field research needs to be done on this aspect. A few growers have caused salt burn on young trees by excessive applications of 'hot' manures.

Initial benefits have been observed using mounds when replanting with G-755, Toro Canyon, Thomas and other resistant rootstocks.

SUMMARY

When using integrated treatments in replanting avocado root rot-diseased sites with partially resistant rootstocks and fungicides, planting the trees on mounds provides an initial benefit of improved growth and health that lasts into the productive life of the trees.

REFERENCES

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